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of  $-85^\circ$ , instead of being nearly circular, as represented in the 3<sup>te</sup> Abtheilung of Plate XVI. of the 'Atlas des Erdmagnetismus,' is an elongated ellipse, much more nearly resembling in form and dimensions the ellipse of  $85^\circ$  of inclination in the northern hemisphere in the same work, Plate XVI. 2<sup>te</sup> Abtheilung. The analogy between the two hemispheres in the characteristic feature of the elliptical form of the higher isoclinical lines is the more important to notice, on account of the particular relation which appears to subsist in the northern hemisphere between the change in the geographical direction of the greater axis of the ellipse, and the secular changes of the inclination generally throughout the hemisphere. The present direction of the greater axis in the northern hemisphere, is nearly N.N.W. and S.S.E., or that of a great circle passing through the two foci of maximum intensity. In the southern hemisphere, the present direction of the greater axis differs little from E.S.E. and W.N.W.

3. Captain Ross's observations of the intensity do not appear to indicate the existence anywhere in the southern hemisphere of a higher intensity than would be expressed by 2.1 of the arbitrary scale. In this respect also the analogy between the two hemispheres appears to be closer than is shown in M. Gauss's maps, Plate XVIII. With respect to the direction of as much of the line of highest intensity (2.0) as it has been possible to draw with any degree of confidence from the observations now communicated, it will be found to be in almost exact parallelism with the isodynamic line of 1.7 in Plate III. of the author's report "On the Variations of the Magnetic Intensity," in the Report of the eighth meeting of the British Association, for 1838; which line was the highest of which the position could be assigned at that period for any considerable distance by the aid of the then existing determinations.

3. "An Account of several new Instruments and Processes for determining the Constants of a Voltaic Circuit," by Charles Wheatstone, V.P.R.S., Professor of Experimental Philosophy in King's College, London, Corresponding Member of the Royal Academy of Sciences at Paris, &c.

The author proposes in the present communication to give an account of various instruments and processes which he has employed during several years past for the purpose of investigating the laws of electric currents. He states that the practical object for which these instruments were originally constructed, was to ascertain the most advantageous conditions for the production of electric effects through circuits of great extent, in order to determine the practicability of communicating signals by means of electric currents to more considerable distances than had hitherto been attempted. Their use, however, is not limited to this special object, but extends equally to all inquiries relating to the laws of electric currents and to every practical application of this wonderful agent.

As the instruments and processes described by the author are all founded on Ohm's theory of the voltaic circuit, he commences with

a short account of the principal results to which this theory leads, and shows how the clear ideas of electromotive forces and resistances, substituted for the vague notions of intensity and quantity which formerly prevailed, furnish us with satisfactory explanations of phenomena, the laws of which have hitherto been involved in obscurity and doubt. According to Ohm's system, the force of the current is equal to the sum of the electromotive forces divided by the sum of the resistances in the circuit. The several electromotive forces and resistances which enter into the circuit of a voltaic battery are then defined; and having frequent occasion to refer to the laws of the distribution of the electric current in the various parts of a circuit, when a branch conductor is placed so as to divert a portion of the current from a limited extent of that circuit, the author directs particular attention to these laws. After recommending several new terms in order to express general propositions, without circumlocution and with greater precision, the author states the method of obtaining the constants of a circuit employed by Fechner, Lenz, Pouillet, &c., and then proceeds to explain the new method he has himself adopted. The principle of this method is the employment of variable instead of constant resistances, bringing, thereby, the currents in the circuits compared to equality, and inferring from the amount of the resistance measured out between two deviations of the needle, the electromotive forces and resistances of the circuit according to the particular conditions of the experiment; a method which requires no knowledge of the forces corresponding to different deviations of the needle. To apply this principle, it is requisite to have a means of varying the interposed resistance, so that it may be gradually changed within any required limits. The author describes two instruments for effecting this purpose; one intended for circuits in which the resistance is considerable, the other for circuits in which it is small. The *Rheostat* (for thus the inventor names the instrument under both its forms) may also be usefully employed as a regulator of a voltaic current, in order to maintain for any required length of time precisely the same degree of force, or to change it in any required proportion; its advantages in regulating electro-magnetic engines and in the operations of voltatyping, electro-gilding, &c. are pointed out.

Various methods of measuring the separate resistances in the circuit, particularly that of the rheometer itself, are next described; and it is shown that the number of turns of the rheostat requisite to reduce the needle of a galvanometer from one given degree to another, is an accurate measure of the electromotive force of the circuit. It is then proved that similar voltaic elements of various magnitudes, conformably to theory, have the same electromotive force; that the electromotive force increases exactly in the same proportion as the number of similar elements arranged in series; and that when an apparatus for decomposing water is placed in a circuit, an electromotive force, opposed to that of the battery, is called into action, which is constant in its amount, whatever may be the number of elements of which the battery consists. The electromotive forces

of voltaic elements formed of an amalgam of potassium with zinc, copper and platina, a solution of a salt of the negative metal being the interposed liquid, are given; the last combination is one of great electromotive energy, and when a voltmeter is interposed in the circuit, it decomposes abundantly the water contained in it. A still more energetic electromotive force is exhibited by a voltaic element, consisting of amalgam of potassium, sulphuric acid, and peroxide of lead. The author then shows, that if three metals be taken in their electromotive order, the electromotive force of a voltaic combination formed of the two extreme metals is equal to the sum of the electromotive forces of the two elements formed of the adjacent metals.

Among the instruments and processes described in the subsequent part of the memoir are the following. 1. An instrument for measuring the resistance of liquids, by which the errors in all previous experiments are eliminated, particularly those resulting from neglecting the contrary electromotive force arising from the decomposition of the liquid. 2. The differential resistance measurer, by means of which the resistances of bodies may be measured in the most accurate manner, however the current employed may vary in its energy. 3. An instrument for ascertaining readily what degree of the galvanometric scale corresponds to half the intensity indicated by any other given degree. 4. A means of employing the same delicate galvanometer to measure currents of every degree of energy, and in all kinds of circuits. 5. Processes to determine the deviations of the needle of a galvanometer corresponding to the degrees of force, and the converse.

4. "On the Organ of Hearing in Crustacea." By Arthur Farre, M.D., F.R.S.

The author finds that in the Lobster (*Astacus marinus*), the organ of hearing consists of a transparent and delicate vestibular sac, which is contained in the base, or first joint of the small antennæ; its situation being indicated externally by a slight dilatation of the joint at this part, and also by the presence of a membrane covering an oval aperture, which is the fenestra ovalis. The inner surface of the sac gives origin to a number of hollow processes, which are covered with minute hairs and filled with granular matter, apparently nervous. A delicate plexus of nerves, formed by the acoustic nerve, which is a separate branch supplied from the supra-œsophageal ganglion, is distributed over the base of these processes and around the sac. Within the sac there are always found a number of particles of siliceous sand, which are admitted, together with a portion of the surrounding water, through a valvular orifice at the mouth of the sac, being there placed apparently for the express purpose of regulating the size of the grains. The author considers these siliceous particles as performing the office of otoliths, in the same way as the stones taken into the stomachs of granivorous birds supply the office of gastric teeth. Several modifications of this structure exhibited in the organs of hearing of the *Astacus fluviatilis*, *Pagurus streb-*